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(54) **SYSTEMS AND METHODS FOR TRACKING USERS OF WEARABLE DEVICES**

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H04W 4/00	(2006.01)

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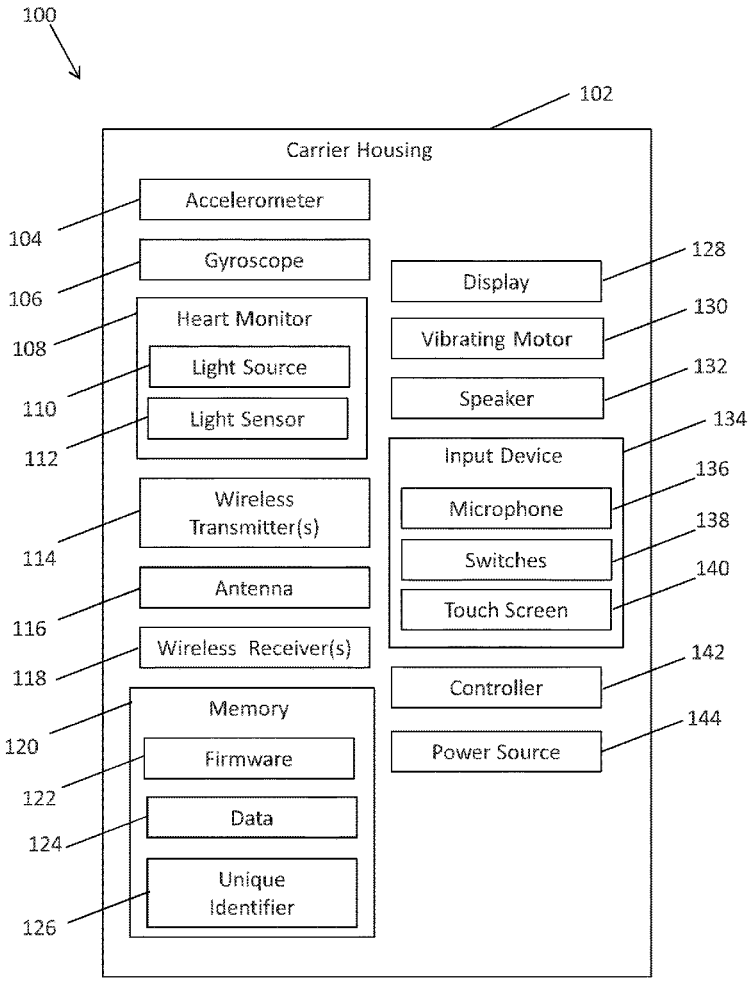
(57) **ABSTRACT**

Exemplary embodiments of the present disclosure are related to a distributed system in which wearable devices communicate with computing systems to implement one or more actions or operations and sensor data transmitted by the wearable devices to the computing systems can be utilized to determine information about tasks being performed by the wearers of the wearable devices. Embodiments of the distributed system can include the wearable devices, wireless receivers (or transceivers), and a computing system.



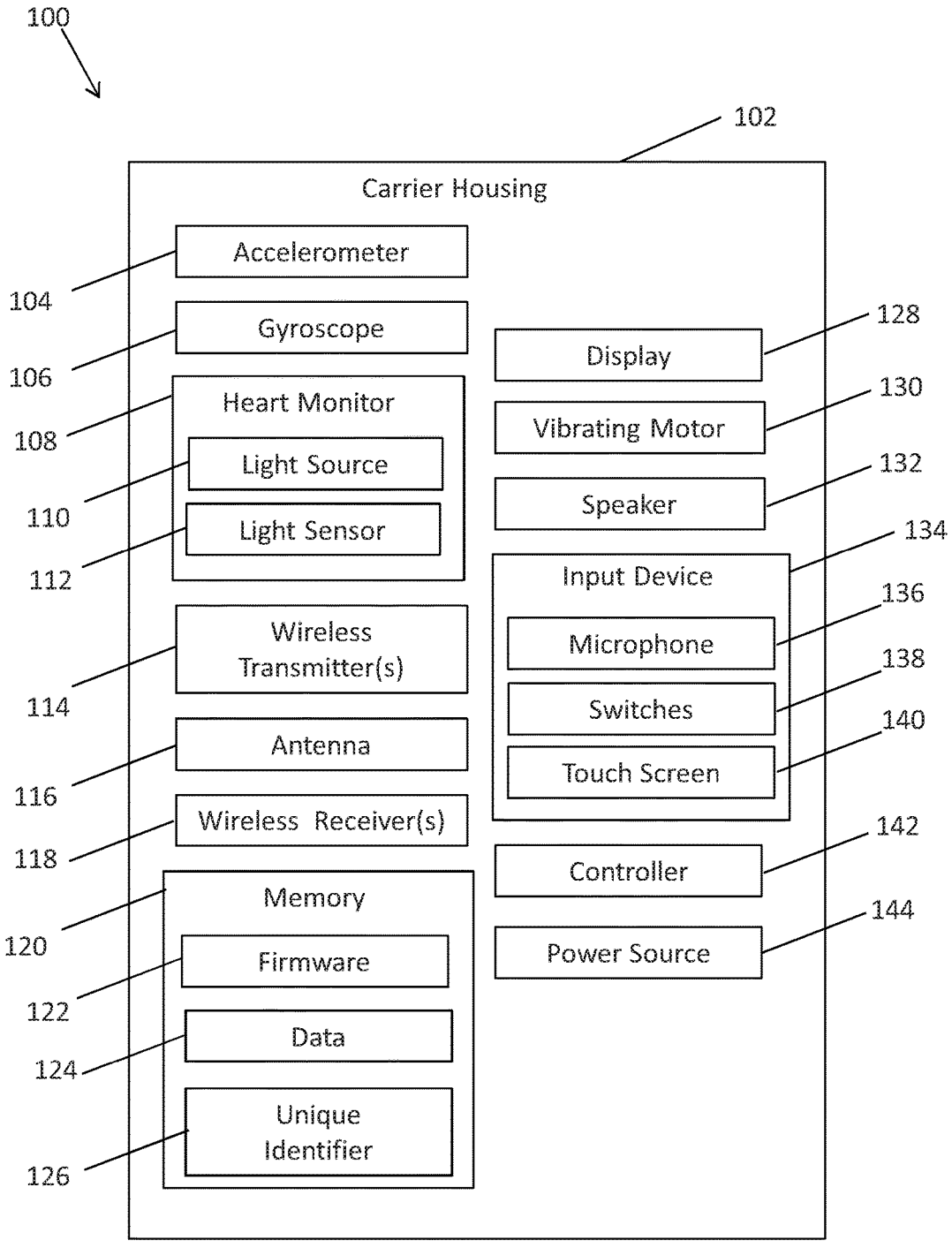

100
102
Carrier Housing
Accelerometer
104
Gyroscope
106
Heart Monitor
108
Light Source
110
Light Sensor
112
Wireless Transmitter(s)
114
Antenna
116
Wireless Receiver(s)
118
Memory
120
Firmware
122
Data
124
Unique Identifier
126
Display
128
Vibrating Motor
130
Speaker
132
Input Device
134
Microphone
136
Switches
138
Touch Screen
140
Controller
142
Power Source
144

FIG. 1

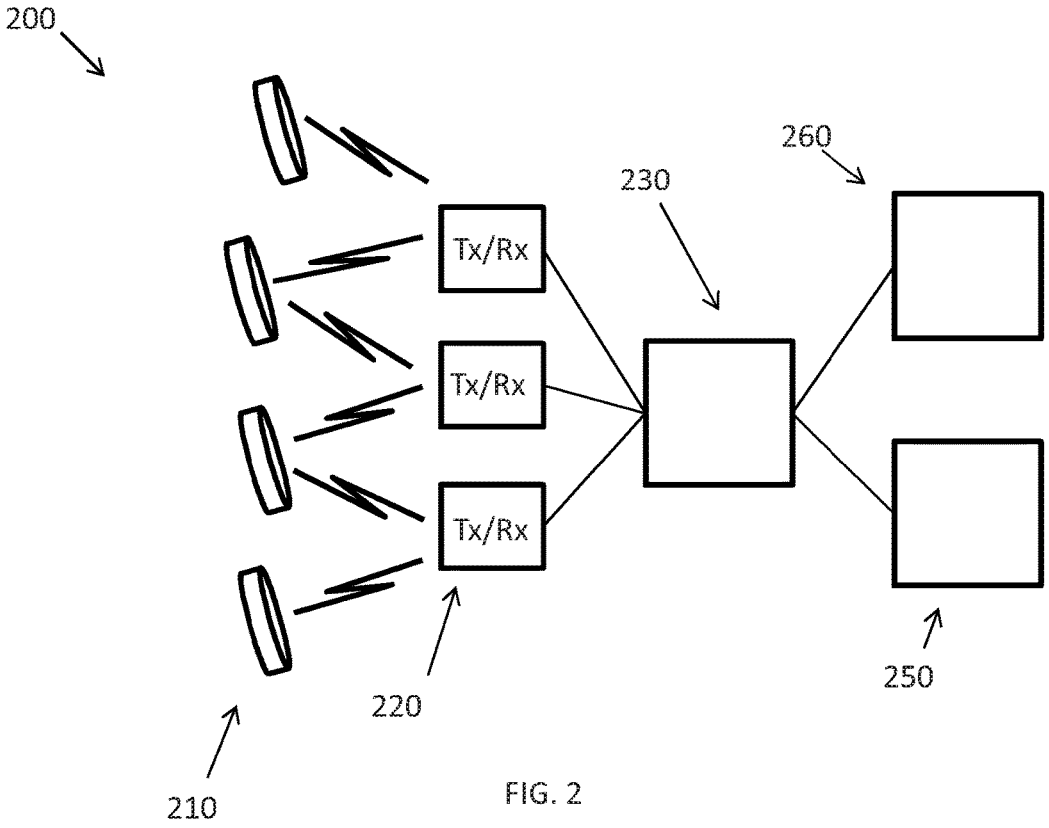


FIG. 2

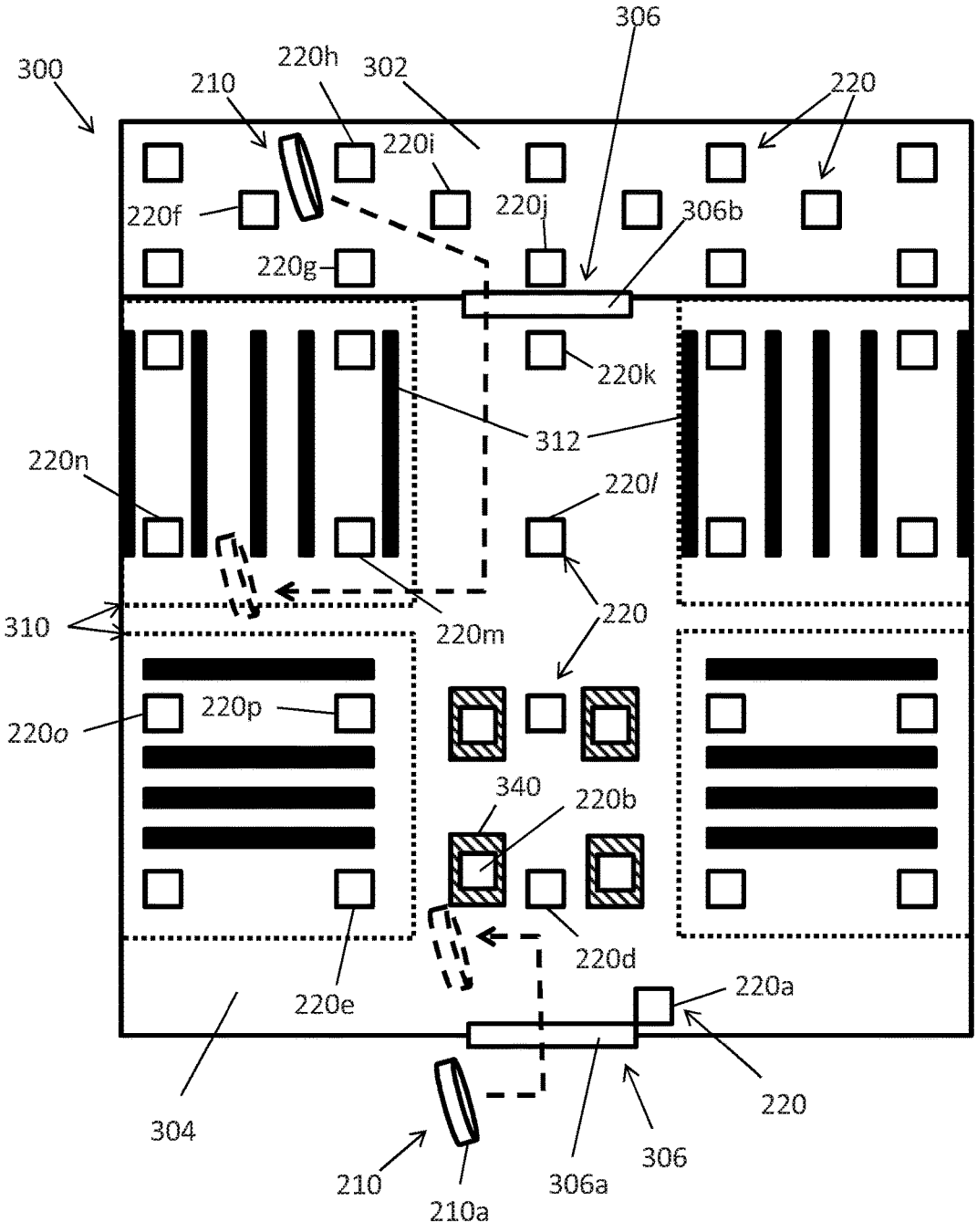

306
300
220h
302
210
220
220i
220f
220j
306b
220g
220k
312
220n
220l
310
220m
220
220p
220o
340
220b
220d
220a
220e
304
220
210
306a
306
210a

FIG. 3

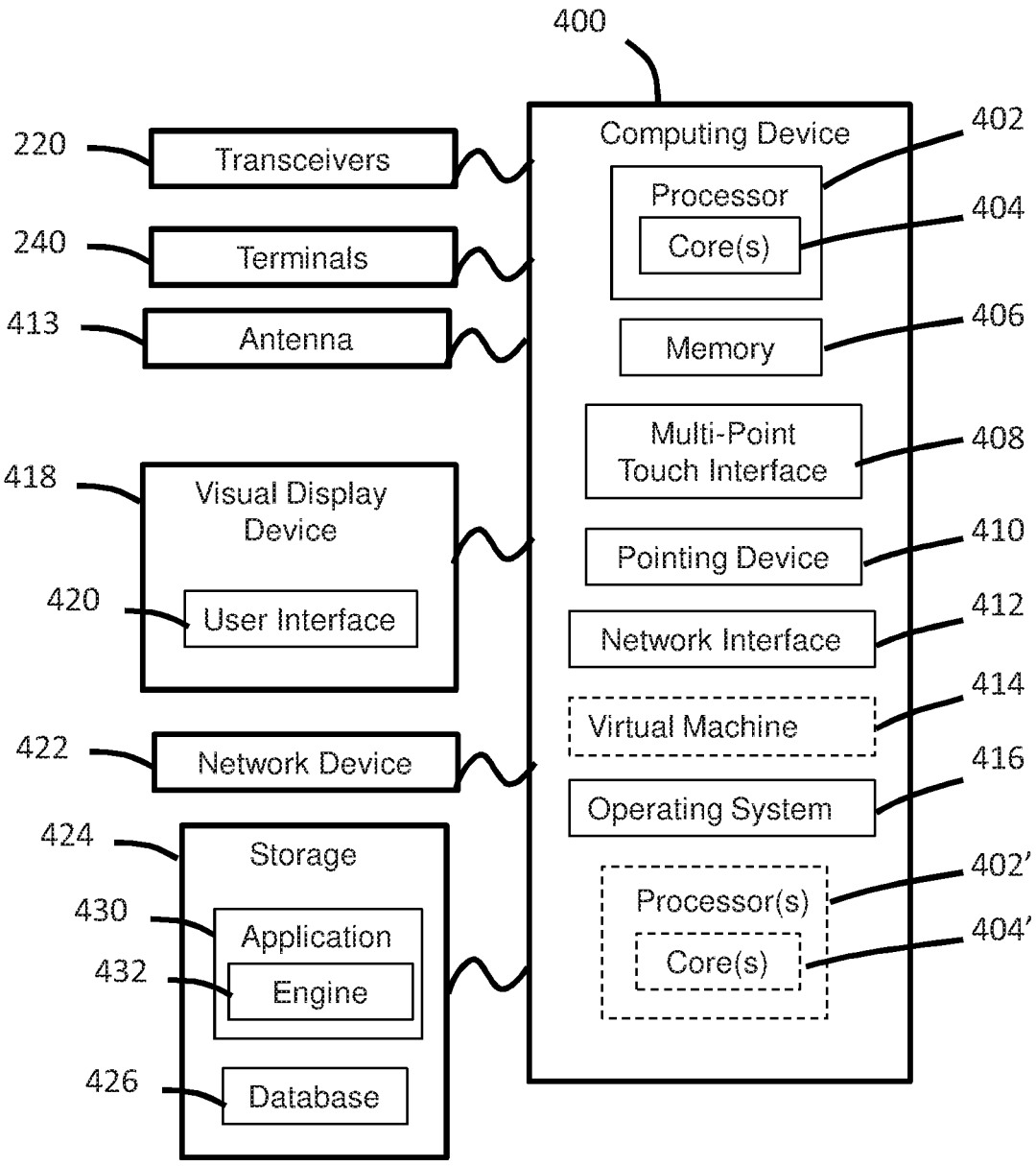

400
Computing Device
402
Processor
Core(s)
404
Memory
406
Multi-Point Touch Interface
408
Pointing Device
410
Network Interface
412
Virtual Machine
414
Operating System
416
Processor(s)
402'
Core(s)
404'
220
Transceivers
240
Terminals
413
Antenna
418
Visual Display Device
420
User Interface
422
Network Device
424
Storage
430
Application
432
Engine
426
Database

FIG. 4

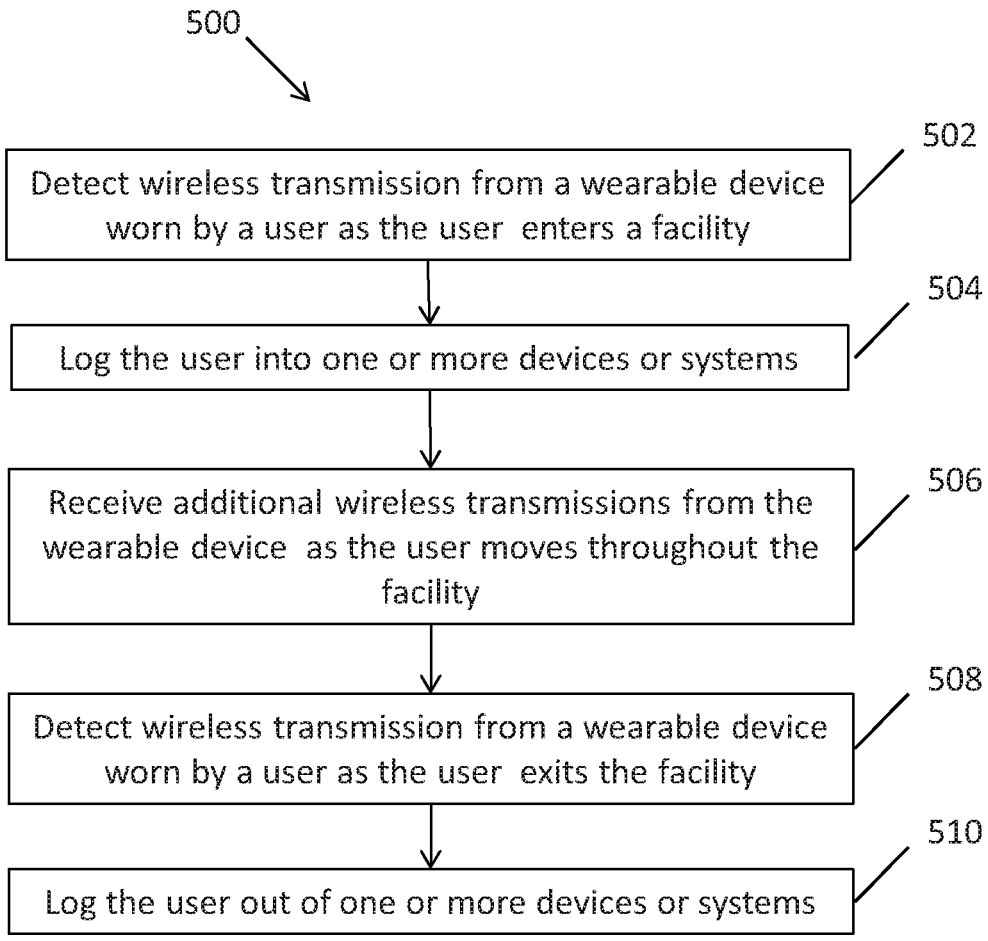

500
Detect wireless transmission from a wearable device worn by a user as the user enters a facility
502
Log the user into one or more devices or systems
504
Receive additional wireless transmissions from the wearable device as the user moves throughout the facility
506
Detect wireless transmission from a wearable device worn by a user as the user exits the facility
508
Log the user out of one or more devices or systems
510

FIG. 5

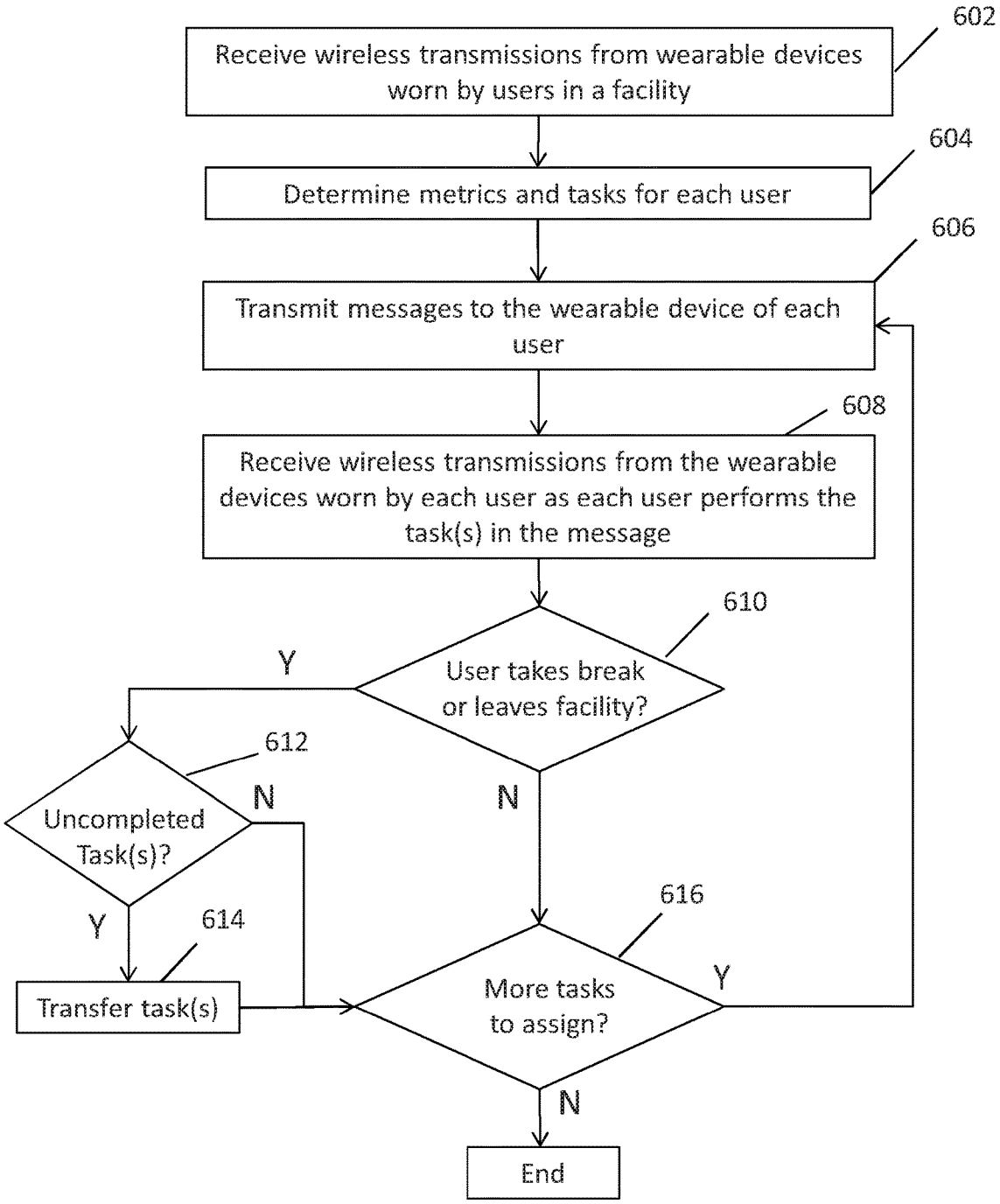

602
Receive wireless transmissions from wearable devices worn by users in a facility
604
Determine metrics and tasks for each user
606
Transmit messages to the wearable device of each user
608
Receive wireless transmissions from the wearable devices worn by each user as each user performs the task(s) in the message
610
User takes break or leaves facility?
Y
N
612
Uncompleted Task(s)?
N
Y
614
Transfer task(s)
616
More tasks to assign?
Y
N
End

FIG. 6

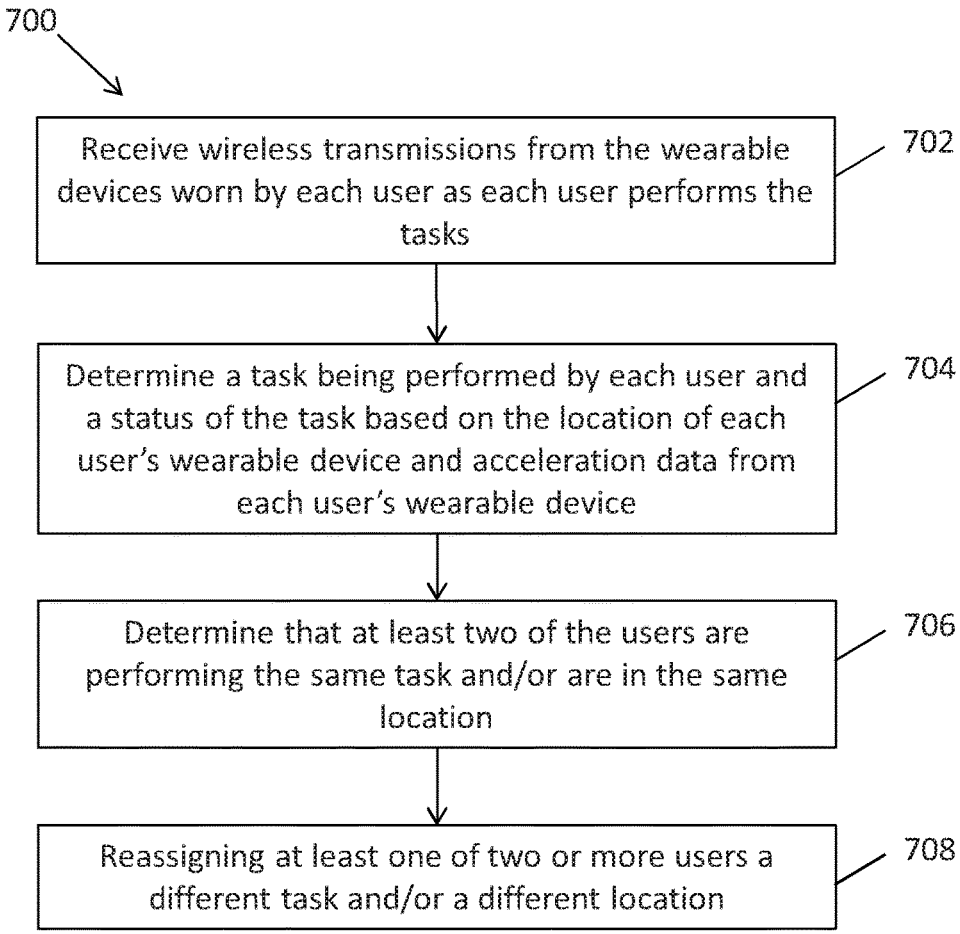

700
Receive wireless transmissions from the wearable devices worn by each user as each user performs the tasks
702
Determine a task being performed by each user and a status of the task based on the location of each user's wearable device and acceleration data from each user's wearable device
704
Determine that at least two of the users are performing the same task and/or are in the same location
706
Reassigning at least one of two or more users a different task and/or a different location
708

FIG. 7

SYSTEMS AND METHODS FOR TRACKING USERS OF WEARABLE DEVICES

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

[0001] This application claims priority to U.S. Provisional Application No. 62/397,146 filed on Sep. 20, 2016, the content of which is hereby incorporated by reference in its entirety.

BACKGROUND

[0002] In large distributed environments, it can be difficult to track resources and to determine how such resources are being utilized.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] The accompanying drawings are not intended to be drawn to scale. In the drawings, each identical or nearly identical component that is illustrated in various figures is represented by a like numeral. For purposes of clarity, not every component may be labeled in every drawing. In the drawings:

[0004] FIG. **1** is a block diagram of an exemplary wearable device in accordance with embodiments of the present disclosure.

[0005] FIG. **2** is a block diagram of an exemplary distributed system utilizing embodiments of the wearable device of FIG. **1** in accordance with embodiments of the present disclosure.

[0006] FIG. **3** is a schematic view of a facility in which embodiments of the distributed system can be implemented in accordance with the present disclosure.

[0007] FIG. **4** is an exemplary computing device for implementing embodiments of the present disclosure.

[0008] FIG. **5** is a flowchart illustrating a process implemented in a user tracking and communication environment in accordance with embodiments of the present disclosure.

[0009] FIG. **6** is a flowchart illustrating a process implemented in a user tracking and communication environment for assigning tasks in accordance with embodiments of the present disclosure.

[0010] FIG. **7** is a flowchart illustrating a process implemented in a user tracking and communication environment for reassigning tasks in accordance with embodiments of the present disclosure.

DETAILED DESCRIPTION

[0011] Exemplary embodiments of the present disclosure are related to a distributed system in which wearable devices communicate with computing systems to implement one or more actions or operations and sensor data transmitted by the wearable devices to the computing systems can be utilized to determine information about tasks being performed by the wearers of the wearable devices. Embodiments of the distributed system can include the wearable devices, wireless receivers (or transceivers), and a computing system.

[0012] Each of the wearable devices can include a carrier housing, such as a wristband, that can be worn by a user. The carrier housing can house an accelerometer, a wireless transmitter, wireless receiver, and a controller, which can be configured to receive acceleration data from the accelerometer and to wireless transmit the acceleration data and a unique identifier. The acceleration data transmitted by a wearable device can be raw acceleration data and/or can be processed acceleration data. For example, the raw acceleration data can be accelerations sensed by the accelerometer with respect x, y, and z components of the acceleration and processed acceleration data can include a quantity of steps taken by the wearer of the wearable device.

[0013] The wireless receivers (or transceivers) can be geographically distributed throughout a facility, and can be configured to receive the acceleration data and unique identifiers transmitted by the wearable devices. For example, a wearable device can transmit acceleration data and a unique identifier associated with the wearable device and the wireless receivers within range of the transmission from the wearable device can receive the acceleration data and the unique identifier, while the wireless receivers that are not in range of the transmission do not receive the transmission. A location of the wearable device can be determined based on which of the wireless receivers receive the transmission from the wearable device and/or based on the signal strength of the transmission when the wireless receivers receive the transmission.

[0014] The computing system can be in communication with the wireless signal receivers and can be configured to receive the transmissions from the wearable devices via the wireless signal receivers. In response to receiving the acceleration data and unique identifier information, the computing system can perform one or more actions or operations. As one example, the computing system can determine that the user of the wearable device has arrived at a location and can set a memory location in a storage device to indicate that the user has arrived at the location and/or can determine that the user of the wearable device has departed from a location and can set a memory location in a storage device to indicate that the user has departed from the location. As another example, the computing system can initiate a multi-factor authentication process using the unique identifier as one factor for authenticating the user before allowing the user to access and operate one or more electronic terminals. Other factors that can be used in the multi-factor authentication process can be, for example, a password, reading a machine-readable element or a magnetic stripe including a unique identifier that is different than the unique identifier transmitted by the wearable device, and like. As another example, the computing system can be configured to determine a task being performed by the wearer of the wearable device, a status of the task being performed by the wearer of the wearable device (e.g., started, in process, completed), and/or other parameters associated with tasks being performed by the wearer of the wearable device.

[0015] In exemplary embodiments, a wearable device can be worn by an associate/employee and can be used to "clock-in" the employee as the employee enters a facility (e.g., based on receipt of a wireless transmission from a wearable device by a wireless signal receive disposed in proximity to an entrance of the facility. Receipt of the transmission from the wearable device by a wireless signal receiver can also be used to log the employee into computing devices that the employee will use during the work shift (e.g., electronic terminals, portable device, etc.). For example, an employee enters the facility wearing a wearable device and can be automatically logged into a timekeeping system that shows the employee as present and logged onto the clock for their shift in response to detecting the wearable

device. Receipt of the acceleration data can also be used to track a relative location of the wearer and the physical steps taken by the wearer. For example, the quantity of steps taken by an employee wearing the wearable device can be monitored and tallied for a task being performed by the employee, and this information can be used to determine how the movement of the employee throughout the facility can be modified to improve performance.

[0016] In exemplary embodiments, during the time an employee is clocked in, until the employee clocks out and departs from the facility after their shift, the distributed system can be used to track an attendance, a location of the employee, and a quantity of steps taken by the employee as the employee is assigned tasks, which can be used to determine where throughout the shift wasted steps are taken by the employee. By tracking the location, the task, and the quantity of steps that a task should take (while averaging that task's time to completion for a given time period), the computing system can determine that an employee was taking too long to complete a task and/or can identify appropriate employees for tasks requiring different levels of physical exertion, determine which employees should be given more or less tasks during a shift, and/or generate paths in the facility that the wearer of the wearable device should follow to complete tasks more efficiently and timely. In some embodiments, the paths generated by the computing system can be dependent on a frequency of the task and a number of steps required for completion. For example, a location and quantity of steps of the wearer of a wearable device can be tracked as the wearer performed a task (e.g., unloading trucks from the back, bringing pallets to unload to the front of the store and unloading and facing stock), and the computing system can use this data to determine the shortest path for the associate to travel when certain item types (e.g. dairy or electronics) arrive and ultimately how, where and when items are placed onto shelves.

[0017] In exemplary embodiments, the distributed system can add user-specific reminders to the wearable devices. Reminders programmed into the wearable devices can cause the wearable devices to vibrate. As an example, the computing system can load a reminder onto a wearable device such that when the wearer's break time is due, the wearable device can vibrate to alert the wearer that it is time for the wearer to take a break. In exemplary embodiments, certain vibration patterns can be programmed into the wearable devices. For example, when a specific vibration pattern can be used to alert a wearer, with the least amount of steps taken for an identified period of time as compared to other wearers, that the next available task for unloading a specific pallet will be assigned to him/her.

[0018] By tracking and calculating the location and number of steps taken for a particular task, for all wearers of the wearable device in a facility, the computing system can determine what tasks each wearer is working on. After identifying the tasks being performed, the computing system can aggregate the number of steps taken for each wearer and determine a status of the task (e.g., how deep the wearers are into their respective tasks). When a new unplanned task needs to be added (e.g., a customer request or happenstance that needs attention), based on the tracked location, number of steps, and status of tasks, the computing system can identify which wearer of the wearable device should be identifier for performing the unplanned task, and can add the new task to the wearer's task. In some embodiments, new tasks can be added to the wearer's task based on a proximity to the location at which the task is to be performed and a status of their current prioritized tasks. In some embodiments, the computing system can notify a manager (e.g., via a portable device carried by the manager or a wearable device worn by the manager) of the unplanned task and which wearer should be assigned to the unplanned task. If a wearer is reassigned to an unplanned task while performing another task, another wear of a wearable device can be assigned to complete the task in order of priority. In some embodiments, a message can be sent to the wearer to be assigned a new task.

[0019] In exemplary embodiments, messages can be sent from to and from wearable devices. As one example, a facility can include a customer interface that allows a customer to post a question or a request to wearers of the wearable devices in the facility and one or more of the wearers can respond to the question (e.g., either by posting an answer to the customer interface or by moving to the customer's location). In some embodiments, in response to the post or request, the computer perform analytics on each wearer of the wearable device to determine their current location and a status of the tasks being performed by the wearers, and based on this analysis, the computing system can identify which of the wearer should receive a message via their wearable device to move to the location of the customer and assist the customer.

[0020] FIG. **1** is a block diagram of an exemplary wearable device **100** in accordance with embodiments of the present disclosure. The wearable device **100** can include a wearable carrier housing **102** configured to be worn by a human. For example, the wearable carrier housing **102** can be a wristband configured to be worn around a human's wrist. Electronic circuitry can be housed by the wearable carrier housing **102**. For example, the wearable carrier housing **102** can house an accelerometer **104**, gyroscope **106**, a heart monitor **108**, a wireless transmitter **114**, antenna **116**, a wireless receiver **118**, memory **120**, a display **128**, a vibrating motor **130**, a speaker **132**, one or more input devices **134**, a controller **142**, and power source **144**. The wearable device **100** can be configured to monitor one or more metrics associated with a wearer of the wearable device **100**, to transmit the metric and a unique identifier associated with the wearable device **100**, and/or receive data from one or more sources.

[0021] The accelerometer **104** can sense accelerations with respect to one or more axes of the accelerometer and generated acceleration data corresponding to the sensed accelerations. For example, the accelerometer **104** can be a multi-axis accelerometer including x, y, and z axes and can be configured to sense accelerations with respect to the x, y, and z axes of the accelerometer. The acceleration data generated by the accelerometer **104** can be used to determine one or more metrics associated with the wearer of the wearable device **100**. For example, the acceleration data generated by the accelerometer **104** can be used to determine a quantity of steps the wearer of the wearable device has taken over time.

[0022] The accelerometer **104** can output acceleration data corresponding to each axes of measurement and/or can output one or more signals corresponding to an aggregate or combination of the three axes of measurement. For example, in some embodiments, the accelerometer **104** can be a three-axis or three-dimensional accelerometer that includes

three outputs (e.g., the accelerometer can output x, y, and z component data). The accelerometer **104** can detect and monitor a magnitude and direction of acceleration, e.g., as a vector quantity, and/or can sense an orientation, vibration, and/or shock. In some embodiments, a gyroscope **106** can be used instead or in addition to the accelerometer **104**, to determine an orientation of wearable device **100**. In some embodiments, the orientation of the wearable device **100** can be used to aid in determining whether the acceleration data corresponds to a step taken by a wearer.

[0023] The heart monitor **108** can be configured to sense a heartbeat of the wearer of the wearable device. Embodiments of the heart monitor **108** can include a light source **110** and a light sensor **112**, where the light source **110** emits light towards a wearer (e.g., towards a wearers wrists) and the light can be reflected from the wearers wrist (e.g., based on a rate at which the blood pulsating through the wrist of the wearer). Based on receiving the reflected light by the light sensor **112**, the heart monitor **108** can generate and output heartbeat data.

[0024] The wireless transmitter **114** can be configured to transmit wireless transmissions via an antenna **116**. For example, the wireless transmitter **114** can be configured to transmit one or more messages, directly or indirectly, to one or more electronic devices. The wireless transmitter **114** can be configured to transmit messages at a specified frequency and/or according to a specified sequence and/or packet arrangement. As one example, the wireless transmitter **114** can be a radiofrequency transmitter. In some embodiments, the wireless transmitter can be configured to transmit radio transmissions in the frequency range of approximately 2.4 gigahertz (GHz) to approximately 5.6 GHz.

[0025] The wireless receiver **118** can be configured to receive wireless transmissions via the antenna **116**. For example, the wireless receiver **118** can be configured to receive one or more messages, directly or indirectly, from one or more electronic devices. The wireless receiver **118** can be configured to receive messages at a specified frequency and/or according to a specified sequence and/or packet arrangement. As one example, the wireless receiver **118** can be a radiofrequency receiver. In some embodiments, the wireless receiver can be configured to receive radio transmissions in the frequency range of approximately 2.4 gigahertz (GHz) to approximately 5.6 GHz.

[0026] The memory **120** can include any suitable, non-transitory computer-readable storage medium, e.g., read-only memory (ROM), erasable programmable ROM (EPROM), electrically-erasable programmable ROM (EEPROM), flash memory, and the like. The memory **120** can store firmware **122** and data **124** for use by the wearable device **100**. In exemplary embodiments, the firmware **122** can be embodied as computer-readable/executable program code stored in the memory **120** and can be implemented using any suitable, high or low level computing language and/or platform, such as, e.g., Java, C, C++, C#, assembly code, machine readable language, and the like. The data **164** can include the acceleration data, the heartbeat data, and/or any other suitable data associated with the wearer or the output of the sensors (e.g., the accelerometer **104** and heart monitor **108**) included in the wearable device **100**. The memory **120** can also store a unique identifier **126** that can be used to distinguish transmissions from the wearable device **100** from transmission from other wearable device **100** and/or to determine transmissions that are intended for the wearable device **100**.

[0027] The display **128** can be integrated with the wearable carrier housing **102** and can be configured to render data/information to be viewed by the wearer. For example, the display can render messages, tasks, a heartrate, a quantity of steps taken, a graphical user interface allowing the wearer to enter data/information, and the like. The screen can include a touch-sensitive screen integrated therewith to allow the wear to control the wearable device **100** via gestures or movements traced on the touch-sensitive screen. In exemplary embodiments, the display **128** can be implemented as a light emitting diode (LED) display.

[0028] The vibrating motor **130** can be configured such that when the motor is energized, the motor operates to generate vibrations. The vibrations can be felt by the wearer of the wearable device **100** to provide indications to the wearer. The vibrating motor **130** can be controlled to generate different vibrations and/or vibration patterns to generate different indicators (e.g., different amplitudes of vibration, different frequencies of vibration, different quantities of pulses of vibrations, etc.).

[0029] The speaker **132** can be configured to output audible sound. For example, the speaker can be configured to output messages, tasks, a current heartrate of the wearer, a current number of steps taken by a wearer for a particular time period or assigned task, and/or to communicate any other suitable data/information to the wearer of the wearable device **100**. In some embodiments, the wearable device **100** may not include the display **128**. In such embodiments, communications from the wearable device **100** to the wearer may be limited to vibrations from the vibrating motor **130** and/or audible sounds output by the speaker **132**.

[0030] The one or more input devices **134** can be configured to allow the wearer of the wearable device **100** to input data/information into the wearable device **100**. Examples of input devices can include a microphone **136**, one or more buttons/switches **138**, the touch sensitive screen **140** integrated with the display **128**, and the like. The microphone **136** can allow the wearer to interact with the wearable using voice commands or message.

[0031] The controller **142** can be operatively coupled to the accelerometer **104**, the gyroscope **106**, the heart monitor **108**, the wireless transmitter **114**, the wireless receiver **118**, the memory **120**, the display **128**, the vibrating motor **130**, the speaker **132**, and the one or more input devices **134**. The controller **142** can execute the firmware **122** in the memory **120** to perform one or more operations to facilitate one or more processes described herein. For example, in exemplary embodiments, the controller **142** can be programmed to execute the firmware **122** to receive and process information/data from the accelerometer **104** (e.g. X, Y, Z data), the gyroscope **106**, the heart monitor **108**, the wireless receiver **118**, the memory **120** and/or can be programmed to output information/data to the wireless transmitter **114**, the memory **120**, and/or the display **128** based on the execution of the firmware **122**. As one example, the controller **142** can receive information/data (e.g., acceleration data) from the accelerometer **104** corresponding to a direction force along one or more of the axes of the accelerometer **104**, and can transmit the acceleration data via the wireless transmitter. As another example, the controller **142** can receive information/data from the accelerometer **104** corresponding to a direc-

tion force along one or more of the axes of the accelerometer **104**, can process the information/data to determine whether the acceleration data corresponds to one or more steps taken by the wearer of the wearable device **100**, and can transmit the quantity of steps detected via the wireless transmitter **114**.

[0032] The power source **144** can be implemented as a battery or capacitive elements configured to store an electric charge, and can provide power the accelerometer **104**, the gyroscope **106**, the heart monitor **108**, the wireless transmitter **114**, the wireless receiver **118**, the memory **120**, the display **128**, the vibrating motor **130**, the speaker **132**, the one or more input devices **134**, and the controller **142**. As one example, in some embodiments, the power source can be a button cell lithium battery. As another example, the power source **144** can be a rechargeable power source, such as a battery or one or more capacitive elements configured to be recharged via a connection to an external power supply and/or to be recharged by an energy harvesting device. As one example, the rechargeable power source can be recharged using solar energy (e.g., by incorporating photovoltaic or solar cells on the housing on the sensor module), through physical movement (e.g., by incorporating a piezoelectric elements in the sensor module), and/or through any other suitable energy harvesting techniques using any suitable energy harvesting devices.

[0033] FIG. **2** is a block diagram of an exemplary distributed system **200** utilizing embodiments of the wearable device of FIG. **1** to implement a user tracking and communication environment in accordance with embodiments of the present disclosure. The distributed system **200** can include wearable devices **210**, wireless transceivers **220** (e.g., formed by wireless receivers and wireless transmitters), and a computing system **230**. In exemplary embodiments, the wearable devices **210** can be implemented as wristbands by embodiments of the wearable devices **100**.

[0034] The wireless transceivers **220** can include a wireless transmitter and a wireless receiver. The wireless transmitter can be configured to transmit wireless transmissions and the wireless receiver can be configured to receive wireless transmissions. As one example, the wireless transmitter can be configured to transmit one or more messages, directly or indirectly, to one or more of the wearable devices **210** and/or to the computing system **230**. As another example, the wireless receiver can be configured to receive one or more messages, directly or indirectly, from one or more of the wearable devices **210** and/or from the computing system **230**. The wireless transmitter and receiver can be configured to transmit and receive messages at a specified frequency and/or according to a specified sequence and/or packet arrangement. As one example, the wireless transmitter and receiver can be a radiofrequency receiver. In some embodiments, the wireless receiver can be configured to receive radio transmissions in the frequency range of approximately 2.4 gigahertz (GHz) to approximately 5.6 GHz.

[0035] The wireless transceivers **220** can be distributed throughout a facility to form a network of wireless transceivers **220** to facilitate communication with the wearable devices **210** when the wearable devices **210** are at the facility and to facilitate uninterrupted communication with the wearable devices **210** as the wearable device move throughout the facility. For example, one of the wearable device **220** can transmit acceleration data and a unique identifier, and at least one of the wireless receivers of the wireless transceivers **220** can be configured to receive the acceleration data and the unique identifier in response to the at least one of the wireless receivers of the wireless transceivers being within a transmission range of the wearable device. A location of the wearable device can be determined based on which of the wireless receivers receive the transmission from the wearable device and/or based on the signal strength of the transmission when the wireless receivers receive the transmission.

[0036] The computing system can be operatively coupled to the wireless transceivers and can be configured to receive data/information from the wireless transceivers **220** and/or to transmit data/information to the wireless transceivers for propagation to the one or more of the wearable devices **220**. In exemplary embodiments, the computing system **230** can include one or more servers implemented by one or more computing devices, such as an example computing device shown in FIG. **4**. The computing system **230** can be configured to execute user tracking and communication engines to perform one or more processes described herein.

[0037] In a non-limiting exemplary operation, the computing system **230** can be in communication with the wireless transceivers **220** and can be configured to receive the transmissions from the wearable devices **210** via the wireless signal receivers **220** and to receive a signal strength of the transmissions from the wearable devices **210** received by wireless transceivers **220**. The wireless transmissions from the wearable devices **210** can include acceleration data and unique identifiers. In response to receiving the acceleration data and the unique identifier from one of the wearable devices **210** (e.g., via transmission from the wearable device to the computing system **230** through the wireless transceiver), the computing system **230** can determine that the user of the wearable device has arrived at a specific location in the facility and can set a memory location in a storage device **260** of the computing system to indicate that the user has arrived at the specific location and/or can determine that the user of the wearable device has departed from a specific location and can set a memory location in the storage device **260** to indicate that the user has departed from the specific location. As one example, the computing system can generate a (first) flag or parameter in a physical memory location of the storage device **260** indicating an arrival of the wearable device in response to receipt of the unique identifier through one or more of the wireless transceivers **220** disposed in proximity to entrance of the facility through which the user of the wearable device enters the facility. Based on the generation of the first flag in the memory location, the user of the wearable device can "clocked-in" to a scheduling system. As another example, the computing system can generate a second flag or parameter in a second physical memory location of the storage device **260** or can reset the first flag in the first physical memory location of the storage device **260** in response to the receipt of the unique identifier by the one or more of the wireless transceivers disposed in proximity to an exit through the user wearing the wearable device departs to indicate a departure of the user wearing the wearable device from the facility. Based on the generation of the second flag or resetting of the first flag, the user of the wearable device can be "clocked-out" of a scheduling system. In some embodiments, a time period can specified that prevents generating the second flag or resetting the first flag until the time period has elapsed. For

example, after the first flag is generated, if the user is detected as departing from the facility within the specified time period after the first flag is set, the computing device **230** can be prevented from generating the second flag or resetting the first flag. In some embodiments, if a user is detected as departing during the specified time period, and is not detected as arriving again within another specified time period, the computing system **230** can generate the second flag or reset the first flag and associate a time stamp with the second flag or the resetting of the first flag corresponding to the time the user was detected as departing from the facility.

[0038] The computing system can grant access and unlock one or more electronic devices in the facility to allow the user to use the one or more electronic devices in response to detecting the arrival of the user wearing one of the wearable devices **210** and/or can restrict access and lock the one or more electronic devices in response to detecting the departure of the user wearing one of the wearable devices **210** from the facility. For example, receipt of the transmission from the wearable device by one or more of wireless receivers can cause the computing system to automatically log the user of the wearable device into computing devices that the user will use during a work shift (e.g., electronic terminals, portable devices, etc.).

[0039] In some embodiments, the electronic devices can implement a multi-factor authentication process (e.g., a two-step authentication process) and the computing system **230** can initiate a multi-factor authentication process using the received unique identifier to provide the electronic device with an authentication code as one factor for authenticating the user before allowing the user to access and operate one or more electronic terminals in the facility. Other factors that can be used in the multi-factor authentication process can be, for example, a password, reading a machine-readable element or a magnetic stripe including a unique identifier that is different than the unique identifier transmitted by the wearable device, and like. For example, one of the wireless transceivers **220** can be dedicated to a specific electronic device such that when the wireless transceiver receives a wireless transmission from one of the wearable devices **210**, the wireless transceiver sends the unique identifier to the computing system **230**, which determines whether the unique identifier should permit the user to access and operate the electronic device. If so, the computing system **230** can provide the electronic device with an authentication code to satisfy one of the authorization factors.

[0040] After flags or parameters are set to indicate the presence of users of the wearable devices **210**, the computing system **230** can track locations of the wearable device **210** in the facility to determine locations of the users. For example, when a user is positioned at a specific location within the facility some of the wireless transceivers **220** can be in range of transmissions from the wearable device of the user such that these wireless transceivers received the transmission and some of the wireless transceivers **220** can be out of range of the transmission such that these wireless transceivers do not receive the wireless transmissions. Based on the locations of the wireless transceivers that receive the transmissions in the facility and the unique identifier included in the transmission, the computing system can estimate a location at which the wearable device that sent the transmission is disposed. For example, in response to a different subset of the wireless transceiver receiving the unique identifier and the acceleration data subsequent to the computing system **230** setting the first flag, the computing system is configured to determine a second location of the user based on the subset of the wireless transceivers that receive the transmissions and a signal strength of received wireless transmissions from the at least one wearable device. The wireless transceivers that receive the transmissions from the wearable device can determine signal strengths at which the transmission was received and the computing device can use the signal strengths to triangulate the estimated location of the wearable device.

[0041] In some embodiments, the computing system **230** can track a user location based on the unique identifier and the acceleration data received by one or more of the wireless transceivers **220**, e.g., subsequent to the computing system setting the first flag. As one example, receipt of the acceleration data can also be used to track a relative location of the wearer and the physical steps taken by the wearer. For example, the quantity of steps taken by an employee wearing the wearable device can be monitored and tallied for a task being performed by the employee, and this information can be used to determine how the movement of the employee throughout the facility can be modified to improve performance. As another example, upon setting the first flag, the computing system **230** can determine that the user of the wearable device is located near the entrance of the facility. Upon receiving subsequent transmissions including the unique identifier and acceleration data, the computing system is configured to estimate a second location of the user of the wearable device based on an aggregation of the acceleration data. For example, the computing system **230** can estimate that the user is at the second location based on its relative location to the first location and the accumulated x, y, and z acceleration data between the first location and the second location.

[0042] In addition to estimating a location of the user of the wearable device, the computing system can determine tasks being performed by the user of the wearable device, a status of the task being performed by the user of the wearable device (e.g., started, in process, completed), and/or other parameters associated with tasks being performed by the user of the wearable device in response to receipt of the acceleration data by at least one of the wireless transceivers from the wearable device and a duration over which the wireless transceiver(s) receive the acceleration data.

[0043] The computing system **230** can be configured to transmit data/information to the wearable devices **210** via the wireless transmitters of the wireless transceivers **220**. For example, the computing device **230**, and subsequently, wireless transmitters of the wireless transceivers **220** can transmit a unique identifier associated with one of the wearable devices **210** and a description of a task, e.g., in response to the first flag being set by the computing system **230**. Upon receipt of the transmission by the wearable device associated with the unique identifier, the controller of the wearable device can render a description of the task on the display of the wearable device.

[0044] For embodiments in which the wearable devices **210** include heart monitors, the controllers of the wearable device can wirelessly transmits heart-rate data output from the heart rate monitor with the unique identifiers and the acceleration data. The heartrate data can be used to determine whether users are currently wearing the wearable

devices **210** (e.g., when no heartrate is detected, the computing system can determine that a user is not wearing the wearable device), and can be used to determine levels of energy being exerted by the users in performing tasks.

[0045] In exemplary embodiments, during the time a user is clocked in, until the user is clocked out and departs from the facility after their shift, the computing system can track an attendance, a location of the user, and a quantity of steps taken by the user as the employee is assigned and performs tasks, By tracking the location, the task, and the quantity of steps that a task should take (while averaging that task's time to completion for a given time period), the computing system **230** can determine that a user is taking longer than anticipated to complete a task and/or can identify appropriate users for tasks requiring different levels of physical exertion, determine which employees should be given more or less tasks during a shift, and/or can generate paths in the facility that the wearer of the wearable device should follow to complete tasks more efficiently and timely (e.g., by identifying paths through the facility that require less steps to complete tasks). In some embodiments, the paths generated by the computing system can be dependent on a frequency of the task and a number of steps required for completion. For example, a location and quantity of steps of the user of a wearable device can be tracked as the user performs a task (e.g., unloading trucks from the back, bringing pallets to unload to the front of the store and unloading and facing stock), and the computing system **230** can use this data to determine the shortest path for the associate to travel when certain item types (e.g. dairy or electronics) arrive and ultimately how, where and when items are placed onto shelves.

[0046] The computing system **230** can add user-specific reminders to the wearable devices **210** via transmissions through the wireless transceivers. Reminders programmed into the wearable devices **210** can cause the wearable devices energize the vibrating motor in the wearable device **210** to vibrate. As an example, the computing system **230** can load a reminder onto a wearable device such that when the user's break time is due, the wearable device worn by the user can vibrate to alert the wearer that it is time for the wearer to take a break. In exemplary embodiments, different vibration patterns can be programmed into the wearable devices for different reminders. For example, when a specific vibration pattern can be used to alert a wearer, with the least amount of steps taken for an identified period of time as compared to other wearers, that the next available task will be assigned to him/her (e.g. unloading a specific pallet).

[0047] By tracking and calculating the location and number of steps taken for a particular task, for all wearers of the wearable device in a facility, the computing system **230** can determine what tasks each wearer is working on. After identifying the tasks being performed, the computing system **230** can aggregate the number of steps taken for each wearer and determine a status of the task (e.g., how deep the wearers are into their respective tasks). When a new unplanned task needs to be added (e.g., a customer request or happenstance that needs attention), based on the tracked location, number of steps, and status of tasks, the computing system **230** can identify which wearer of the wearable device should be identifier for performing the unplanned task, and can add the new task to the wearer's task. In some embodiments, new tasks can be added to the wearer's task based on a proximity to the location at which the task is to be performed and a status of their current prioritized tasks. In some embodiments, the computing system can notify a manager (e.g., via a portable device carried by the manager or a wearable device worn by the manager) of the unplanned task and which wearer should be assigned to the unplanned task. If a wearer is reassigned to an unplanned task while performing another task, another wear of a wearable device can be assigned to complete the task in order of priority. In some embodiments, a message can be sent to the wearer to be assigned a new task.

[0048] In exemplary embodiments, messages can be sent from to and from wearable devices. As one example, a facility can include a customer interface **250** that allows a customer to post a question or a request to wearers of the wearable devices in the facility and one or more of the wearers can respond to the question (e.g., either by posting an answer to the customer interface **250** or by moving to the customer's location). In some embodiments, in response to the post or request, the computer system **230** can perform analytics on each wearer of the wearable device to determine their current location and a status of the tasks being performed by the wearers, and based on this analysis, the computing system can identify which of the wearer should receive a message via their wearable device to move to the location of the customer and assist the customer.

[0049] FIG. **3** is a schematic view of a facility **300** in which embodiments of the distributed system can be implemented in accordance with the present disclosure. As shown in FIG. **3**, the facility can have rooms **302** and **304**. Wireless transceivers **220** can be distributed throughout the rooms **302** and **304**. As one non-limiting example, the wireless transceivers **220** can be distributed to form a grid where the wireless transceivers are uniformly spaced from each other. Wireless transceivers **220** can also be disposed in proximity to entrances/exits **306** as well as in proximity to or integrated within electronic terminals **340**. The facility **300** can include areas or departments **310** within which one or more structures, such as storage/display shelves **312** can be disposed. The shelves **312** can be configured to support or other hold physical objects.

[0050] Users in the facility **300** can wear wearable devices **210**, which can be formed, for example as wristbands, as described herein. When users enter or approach the facility, one or more of the transceivers **220** can detect an wireless transmission from the wearable devices **210** worn by the users and can transmit the data/information included in the wireless transmission to the computing system **230** (FIG. **2**). In response to receipt of the data/information, the computing can perform one or more actions or operations, such as one or more actions or operations described herein.

[0051] As one example, a user wearing a wearable device **210***a* can enter the facility through an entrance/exit **306***a*. As the user walks into the facility **300** through the entrance/exit **306***a*, a transceiver **220***a* can detect a wireless transmission from the wearable device **210***a*. As described herein, the wireless transmission can include, for example, a unique identifier associated with the wearable device **210***a* and acceleration data sensed by the accelerometer of the wearable device **210***a* (e.g., a quantity of steps taken by the user). The data/information received by the transceiver **220***a* can be transmitted to the computing system, which can determine whether the wearable device was previously detected by the transceiver **220***a* with a specified time period, and whether any flags have been set in memory to indicate the

presence of the wearable device **210***a* at the facility or to indicate the departure of the wearable device **210***a* from the facility **300**. In response to determining that the wearable device **210***a* is arriving at the facility **300**, the computing system, based on the detection of the wearable device **210***a* by the transceiver **220***a*, can set a flag in memory to indicate that the user wearing the wearable device **210***a* has arrived at the facility and can log the user into one or more devices or systems at the facility.

[0052] As the user wearing the wearable device moves through the facility different subsets of the transceivers can detect wireless transmissions from the wearable device **210***a*. For example, the user may move towards and/or arrive at the electronic terminal **340**, and transceivers **220***b*, **220***c*, **220***d*, and **220***e* can be within range of the wireless transmission, such that the transceivers **220***b*, **220***c*, **220***d*, and **220***e* can each receive the wireless transmission. The location of the wearable device **210***a* in the facility can be estimated by the computing system based on which of the transceivers **220** received the wireless transmission (e.g., transceivers **200***b-e* in the present example), a magnitude or power of the wireless transmission at which the transceivers **220***b-e* received the wireless transmission, and a location of the transceivers **220***b-e*. In addition, or in the alternative, the location of the wearable device **210***a* can be estimated based on the acceleration data received in wireless transmissions received by the transceivers **220**. For example, the computing system can receive the acceleration data from the transceiver **220***a* when the user wearing the wearable device **210***a* enters the facility through the entrance **306***a* and can continue to receive acceleration data from the wearable device **210***a* as the user wearing the wearable device **210***a* moves through the facility (e.g., as received via the transceivers **220***b-e*). The computing system can accumulate and/or aggregate the acceleration data to determine the location of the user. For example, the computing system can set the acceleration data received as the user enters the facility **300** to be an origin and can determine the location of the user relative to the origin based on the acceleration data received by the computing system. In some embodiments, the computing system can use the acceleration data in combination with which of the transceivers **220** received the wireless transmission, a magnitude or power of the wireless transmission at which the transceivers **220***b-e* received the wireless transmission, and a location of the transceivers **220***b-e* to estimate a location of the wearable device **210***a*.

[0053] When the user arrives at the electronic terminal **340** such that the transceiver **220***b* receives a wireless transmission from the wearable device **210***a*, the electronic terminal **340** can initiate a log in process and can use the unique identifier included in the wireless transmission as an authentication parameter for allowing the user to access and operate the electronic terminal **340**. The user may then enter additional authentication parameters into the electronic device **340** via a user interface before access is granted to the user. In response to receiving the wireless transmission via the transceiver **220***a* and receiving input from the user via the electronic terminal **340**, the computing system can autonomous determine a task being performed by the user and whether that task corresponds to one or more tasks assigned to the user.

[0054] When the user wearing the wearable device **210***a* moves away from the electronic terminal **340**, such that the transceiver **220***b* no longer receives wireless transmission from the wearable device **210***a*, the electronic device **340** can log the user out or otherwise lock the access and/or operation of the electronic terminal. In response to no longer receiving wireless transmissions via the transceiver **220***a*, the computing system can autonomous determine a task being performed by the user is complete or on hold.

[0055] As another example, a user wearing a wearable device **210***b* can be in the room **302**, and transceivers **220***f-g* can receive wireless transmissions from the wearable device **210***b*. The location of the wearable device **210***b* in the facility **300** can be estimated based on the acceleration data received in the wireless transmissions, which of the transceivers **220** received the wireless transmission, a magnitude or power of the wireless transmission at which the transceivers **220***f-g* received the wireless transmission, and/or a location of the transceivers **220***f-g* to estimate a location of the wearable device **210***a*. Upon receiving wireless transmissions from the wearable device **210***b* (via the transceivers **220***f-g*), the computing system can determine what task is being performed by the user. The computing system can determine a task being performed by the user wearing the wearable device **210***b* based on the location of the wearable device **210***b*, a duration that the wearable **210***b* remains in the location, acceleration data (e.g., a quantity of steps taken by the user) received by the computing system, a time of day when the user is at the location, a list of tasks assigned to the user for a specified time period, and the like. For example, a number of tasks can be assigned to a user for an eight hour period and a prioritized order can be applied to the tasks such that certain tasks should be completed before other tasks. The computing system can estimate a time period required to complete each task. The computing system can determine whether the wearable device **210***b* is a location associated with one or more of the tasks to be completed for a specified period of time, and can determine that based on the location and the assigned, prioritized tasks, the user is performing a given one of the tasks. In addition, or in the alternative, the user can enter an input into the wearable device **210***b* to indicate which task the user is performing when the user starts the task.

[0056] As the user performs the task, the user may move through the facility **300**. For example, the user may be in the room **302** and may move through the entrance/exit **306***b* to the room **304**, and to the through the entrance/exit **306***a* to one or more of the areas or departments **310**. For example, the user may be moving physical objects from the room **302** to one or more of the storage/display shelves **312** in one or more of the areas or departments **310** within which one or more storage/display shelves **312** are disposed. The user may have to move back and forth between the room **302** and the room **304** several terms during the task and may take one or more paths. The computing system can track the one or more paths taken by the user as the user moves between the room **302** and the **304** based on the acceleration data included in wireless transmissions from the wearable device **210***b*, which of the transceivers **220** receive the wireless transmissions, a magnitude or power of the wireless transmissions at which the transceivers **220** receive the wireless transmissions, and locations of the transceivers **220** that receive the wireless transmissions. For example, the user may move from the room **302** to the room **304** along a path **308** such that as the user moves along the path **308** different

subsets of transceivers **220***e-p* can receive wireless transmissions based on the location of the wearable device **210***b* and the transceivers **220***e-p*.

[0057] After the computing device determines that a task has been initiated, the computing device can track the acceleration data in the wireless transmissions from the wearable device **210***b* to determine status of the task as well as an efficiency with which the task is being performed. For example, the computing system can maintain a quantity of steps taken by the user since the task was started and can estimate a percent completion of the task based on the quantity of steps taken. In exemplary embodiments, the computing system can access a database based on the task being performed to retrieve an estimated total quantity of steps required to complete the task, and can compare the current quantity of steps taken by the user with the estimated total quantity of steps required to complete the task, and can determine the status of the task based on a ratio between the current quantity of steps taken and the estimated total quantity of steps required. The computing device can determine that a task has been completed based on the quantity of steps taken by the user during the task, a location of the user that deviates from an expected location of the user while performing the task, and/or if the computing device determines that the user has started a new task.

[0058] FIG. **4** is an exemplary computing device **400** for implementing embodiments of the present disclosure. The computing device **400** includes one or more non-transitory computer-readable media for storing one or more computer-executable instructions or software for implementing exemplary embodiments. The non-transitory computer-readable media may include, but are not limited to, one or more types of hardware memory, non-transitory tangible media (for example, one or more magnetic storage disks, one or more optical disks, one or more flash drives, one or more solid state disks), and the like. For example, memory **406** included in the computing device **400** may store computer-readable and computer-executable instructions or software (e.g., applications **430**, such as user tracking and communication engines **432**) for implementing exemplary operations of the computing device **400** and performing one or more processes associated with embodiments of the distributed system including processes implemented by embodiments of the computing system **230** shown in FIG. **2**. The computing device **400** also includes configurable and/or programmable processor **402** and associated core(s) **404**, and optionally, one or more additional configurable and/or programmable processor(s) **402'** and associated core(s) **404'** (for example, in the case of computer systems having multiple processors/cores), for executing computer-readable and computer-executable instructions or software stored in the memory **406** and other programs for implementing exemplary embodiments of the present disclosure. Processor **402** and processor(s) **402'** may each be a single core processor or multiple core (**404** and **404'**) processor. Either or both of processor **402** and processor(s) **402'** may be configured to execute one or more of the instructions described in connection with computing device **400**.

[0059] Virtualization may be employed in the computing device **400** so that infrastructure and resources in the computing device **400** may be shared dynamically. A virtual machine **412** may be provided to handle a process running on multiple processors so that the process appears to be using only one computing resource rather than multiple computing resources. Multiple virtual machines may also be used with one processor.

[0060] Memory **406** may include a computer system memory or random access memory, such as DRAM, SRAM, EDO RAM, and the like. Memory **406** may include other types of memory as well, or combinations thereof.

[0061] The computing device **400** can receive data from the transceivers **220**, electronic terminals **340**, as well as other networked device. An operator may interact with the computing device **400** through a visual display device **414**, such as a computer monitor, which may display one or more graphical user interfaces **416**, multi touch interface **420** and a pointing device **418**.

[0062] The computing device **400** may also include one or more storage devices **426**, such as a hard-drive, CD-ROM, or other computer readable media, for storing data and computer-readable instructions and/or software that implement exemplary embodiments of the present disclosure (e.g., user tracking and communication engines **432**). For example, exemplary storage device **426** can include one or more databases **428** for storing information regarding data/information received from wearable device via the transceivers **220**, tasks associated with users of the wearable device, statuses of the tasks being performed by the users, presence and departure of the users, metrics associated with completed tasks, and the like. The databases **428** may be updated manually or automatically at any suitable time to add, delete, and/or update one or more data items in the databases.

[0063] The computing device **400** can include a network interface **408** configured to interface via one or more network devices **424** with one or more networks, for example, Local Area Network (LAN), Wide Area Network (WAN) or the Internet through a variety of connections including, but not limited to, standard telephone lines, LAN or WAN links (for example, 802.11, T1, T3, 56 kb, X.25), broadband connections (for example, ISDN, Frame Relay, ATM), wireless connections, controller area network (CAN), or some combination of any or all of the above. In exemplary embodiments, the computing system can include one or more antennas **422** to facilitate wireless communication (e.g., via the network interface) between the computing device **400** and a network and/or between the computing device **400** and other computing devices (e.g., transceivers **220**). The network interface **408** may include a built-in network adapter, network interface card, PCMCIA network card, card bus network adapter, wireless network adapter, USB network adapter, modem or any other device suitable for interfacing the computing device **400** to any type of network capable of communication and performing the operations described herein.

[0064] The computing device **400** may run any operating system **410**, such as any of the versions of the Microsoft® Windows® operating systems, the different releases of the Unix and Linux operating systems, any version of the MacOS® for Macintosh computers, any embedded operating system, any real-time operating system, any open source operating system, any proprietary operating system, or any other operating system capable of running on the computing device **400** and performing the operations described herein. In exemplary embodiments, the operating system **410** may be run in native mode or emulated mode. In an exemplary

embodiment, the operating system **410** may be run on one or more cloud machine instances.

[0065] FIG. **5** is a flowchart illustrating a process **500** implemented in a user tracking and communication environment for responding to arrivals and departures of users in accordance with embodiments of the present disclosure. At step **502**, a user wearing a wearable device (e.g., wearable device **210** shown in FIG. **2**) arrives at the facility and enters the facility through a door. The computing system executing the user tracking and communication engine can detect the user's presence based on receipt of a wireless transmission from the user's wearable device by a transceiver disposed proximate to the door. At step **504**, the user is automatically logged in to a computing system and/or logged in to one or more electronic terminals or devices in the facility and is authorized for access to specified areas of the facility by the computing system. At step **506**, additional wireless transmissions are detected from the user's wearable device as the user moves throughout the facility. For example, user metrics/details (e.g., user location, acceleration data, etc.) included in the wireless transmissions from are received by transceivers distributed throughout the facility and are forwarded to the computing system.

[0066] The computing system can identify user's that have been logged into the computing system based on detecting their wearable devices and can assign tasks to the user based on the location of the user, the role of the user, the duration the user is expected to be in the facility, the types of tasks available, a quantity of users in the facility, user details associated with other users in the facility, and the like. The wearable device of the user receives a message from the computing system (e.g., via the transceivers) notifying the user of a task start location and required task to be completed. A manager can interact with the computing system via a manager's wearable device, an electronic terminal, a hand-held electronic device, and/or any other suitable device to update or modify tasks assigned to or being assigned to the users. The manager can receive notifications and reports for all users logged in to the computing system via their wearable devices. In some embodiments, the reports can include available tasking, assigned tasking, time to complete assigned tasks, user locations, time remaining for tasks to be completed, a number of users logged into the computing system via their wearable devices, and the like.

[0067] While the user is in the facility, the user can take a break (scheduled or unscheduled), and can interface with the wearable device to provide an input to indicate that the user should be logged off the computing system for break. When the user is on a break, the computing system can determine what task or task(s) have been or were going to be assigned to the user and can determine whether to reassign the task or tasks to other users based on an availability of other user, locations of other users, an anticipated duration of the break, an expected amount of time for completing the task or tasks, and the like. If the computing system determines to reassign the task or tasks, the computing system transmit messages to other users that have been logged in to the computing system via the wearable device to reassign the task or tasks to one or more users.

[0068] At step, **508** the user can leave the facility (e.g., at the end of their shift), and the computing system can detect that user has exited the facility. For example, wireless transmissions from the wearable device worn by the user can be received by one or more transceivers disposed proximate to the door. Upon determining the that user has exited the facility, at step **510**, the computing system can log the user out of the computing system and/or can log the user out of electronic terminals or devices in the facility.

[0069] FIG. **6** is a flowchart illustrating a process **600** implemented in a user tracking and communication environment for assigning tasks to users in accordance with embodiments of the present disclosure. At step **602**, wireless transmissions can be received by a computing system from wearable devices worn by users. For example, wireless transmission from the wearable devices worn by the users can be received by one or more transceivers distributed through the facility and the one or more transceivers can transmit the data/information received in the wireless transmissions, directly or indirectly, to the computing system. The data/information included in each wireless transmission can include, for example, a unique identifier associated with the wearable device sending the wireless transmission and acceleration data (e.g., raw acceleration data output from the accelerometer of the wearable device or processed acceleration data, such a quantity of steps taken by the user of the wearable device). In some embodiments, the data/information can also include inputs from the user and/or any other suitable data/information.

[0070] At step **604**, the computing system can individually and/or collectively determine metrics for the users wearing the wearable devices, can determine tasks being performed by the users, and/or can determine tasks to assign to the users based on the data/information received via the wireless transmissions and locations of the users. At step **606**, the computing system can transmit messages to the wearable devices worn by the users. The messages can include one or more tasks to be performed by the users and/or can include other data/information for the users or to be processed by the wearable devices. The computing system can directly or indirectly send messages to one or more of the transceivers in the facility and the transceivers can broadcast messages. The messages can be received by the wearable devices that within range of the transmission from the transceivers. Each wearable device can determine whether a message is intended for it based on one or more identifiers included in the message. For example, the message can include a unique identifier associated with a specific wearable device such that the wearable device can determine that the message is intended for the wearable device based on the inclusion of the unique identifier in the message and other wearable device can determine that the message was not intended for them based on the absence of their unique identifier. In some embodiments, a message can be intended for all of the wearable device and/or a subset of the wearable devices. In such embodiments, the message can include a universal identifier that corresponds to all of the wearable device or to a specific subset of the wearable devices.

[0071] At step **608**, wireless transmissions from the wearable devices worn by the users can be received by the computing system (e.g., via the transceivers) as each of the users performs their tasks. Each wireless transmission can include a unique identifier and acceleration data. A location of each wearable device can be determined based on the location of the one or more transceivers that receive the wireless transmission and a power of the wireless signal received at the one or more transceivers. Based on the acceleration data and the location of the wearable devices, the computing system can determine which tasks are being

performed and/or a status of the tasks being performed (e.g., a percent completed, a duration of time over which the task is being performed, etc.). To determine the status of the task, the computing system can determine an estimated quantity of steps required to complete the task and/or an estimated duration of time required to complete the task, and can compare the quantity of steps taken by the user performing the task (e.g., from the estimated time the user started the task) to the estimated required steps and/or can compare the duration of time over which the user has been performing the task (e.g., from the estimated time the user started the task) to the estimated duration of time required to complete the task.

[0072] At step **610**, the computing system determines whether a user wearing the wearable device has left the facility or has taken a break. If so, in some embodiments, at step **612**, the computing device can determine whether the user was working on an open (uncompleted) task when the user left, and if so, at step **614**, the computing system can transfer the task to another user in the facility based on the current location and task(s) assigned to the other user (e.g., by transmitting a message to the other user's wearable device assigning the task to the other user).

[0073] When the computing device determines that one or more users are or will be available to perform additional tasks, at step **616**, the computing system can determine whether there are additional tasks to assign to the users. If so, the process **600** repeats from step **606**. If not, the process ends.

[0074] FIG. **7** is a flowchart illustrating a process **700** implemented in a user tracking and communication environment for reassigning tasks in accordance with embodiments of the present disclosure. As step **702**, wireless transmissions can be received by a computing system from wearable devices worn by users. For example, wireless transmission from the wearable devices worn by the users can be received by one or more transceivers distributed through the facility and the one or more transceivers can transmit the data/information received in the wireless transmissions, directly or indirectly, to the computing system. The data/information included in each wireless transmission can include, for example, a unique identifier associated with the wearable device sending the wireless transmission and acceleration data (e.g., raw acceleration data output from the accelerometer of the wearable device or processed acceleration data, such a quantity of steps taken by the user of the wearable device). In some embodiments, the data/information can also include inputs from the user and/or any other suitable data/information.

[0075] As step **704**, the computing device can determine a task being performed by each user and a status of the task based on the location of each user's wearable device and acceleration data from each user's wearable device. At step **706**, the computing system can determine that at least two of the users are performing the same task and/or are in the same location. At step **708**, the computing system can reassign at least one of two or more users a different task and/or to a different location. For example, the computing system can reassign the at least one of the two users based on a which of the users performing the same task and/or who are in the same location has completed less of the task (e.g., based on an estimated start time of each user and a quantity of steps taken by each user), based which of the at least one of the two users has taken more or fewer steps while in the facility, based on a scheduled departure time of the users, and the like.

[0076] In describing exemplary embodiments, specific terminology is used for the sake of clarity. For purposes of description, each specific term is intended to at least include all technical and functional equivalents that operate in a similar manner to accomplish a similar purpose. Additionally, in some instances where a particular exemplary embodiment includes a plurality of system elements, device components or method steps, those elements, components or steps may be replaced with a single element, component or step. Likewise, a single element, component or step may be replaced with a plurality of elements, components or steps that serve the same purpose. Moreover, while exemplary embodiments have been shown and described with references to particular embodiments thereof, those of ordinary skill in the art will understand that various substitutions and alterations in form and detail may be made therein without departing from the scope of the invention. Further still, other aspects, functions and advantages are also within the scope of the invention.

[0077] Exemplary flowcharts are provided herein for illustrative purposes and are non-limiting examples of methods. One of ordinary skill in the art will recognize that exemplary methods may include more or fewer steps than those illustrated in the exemplary flowcharts, and that the steps in the exemplary flowcharts may be performed in a different order than the order shown in the illustrative flowcharts.

1. A distributed system comprising:

a plurality of wearable devices, each of the plurality of wearable device comprising:

an accelerometer;

a wireless transmitter;

a controller operatively coupled to the accelerometer and the wireless transmitter, the controller being configured to receive acceleration data output from the accelerometer and to wirelessly transmit the acceleration data with a unique identifier; and

a band housing the accelerometer, the wireless transmitter, and the controller, the band being configured to be worn by a human;

a plurality of wireless receivers distributed throughout a facility, at least one of the plurality of wireless receivers configured to receive the acceleration data and the unique identifier wirelessly transmitted from at least one of the plurality of wearable devices in response to the at least one of the plurality of wireless receivers being within a transmission range of the at least one of the plurality of wearable devices; and

a computing system operatively coupled to the wireless signal receivers, the computing system being configured to (i) generate a first parameter in a physical memory location indicating an arrival of the wearable device in response to receipt of the unique identifier and (ii) determine a status of a task being performed by the human in response to receipt of the acceleration data by the at least one of the plurality of wireless receivers and a duration over which the at least one of the plurality of wireless receivers receives the acceleration data.

2. The distributed system of claim **1**, wherein the computing system is configured to at least one of set a second parameter in a second physical memory location or reset the

first parameter in the first physical memory location in response to the receipt of the unique identifier a second time by the at least one of the plurality of wireless receivers to indicate a departure of the human wearing the wearable device from the facility.

3. The distributed system of claim **1**, wherein the computing system is configured to set the second parameter or reset the first parameter in response to receipt of the unique identifier the second time occurring after a time period as elapsed.

4. The distributed system of claim **1**, wherein in response to receipt of the unique identifier wirelessly transmitted from the at least one of the plurality of wearable devices by the at least one of the wireless receivers, the computing system is configured to establish a first location of the at least one of the plurality of wearable devices.

5. The distributed system of claim **1**, wherein in response to the plurality of wireless receivers receiving the unique identifier and the acceleration data subsequent to the computing system setting the first parameter, the computing system is configured to determine a second location of the human based on an aggregation of the acceleration data.

6. The distributed system of claim **1**, wherein in response to a subset of the plurality of wireless receivers receiving the unique identifier and the acceleration data subsequent to the computing system setting the first parameter, the computing system is configured to determine a second location of the human based on the subset of the plurality of wireless receivers and a signal strength of received wireless transmissions from the at least one wearable device.

7. The distributed system of claim **1**, further comprising a plurality of wireless transmitters geographically distributed throughout a facility,

wherein the plurality of wireless transmitters are configured to wirelessly transmit the unique identifier and a description of the task to the at least one wearable device in response to the first parameter being set by the computing system, and

wherein the at least one wearable device comprises:

a wireless receiver operatively coupled to the controller to receive the unique identifier and the description of the task; and

a display embedded in the carrier and operatively coupled to the controller, the display being controlled by the controller to render the description of the task on the display.

8. The distributed system of claim **1**, further comprising a computer terminal configured to receive the unique identifier transmitted from the at least one wearable device in response to the computing terminal being within a transmission range of the computer terminal, and to accept the unique identifier as a first step authentication code in a two-step authentication process to log on to the computer terminal.

9. The distributed system of claim **1**, wherein the at least one wearable device comprises a heart rate monitor, and the controller wirelessly transmits heart-rate data output from the heart rate monitor, and the computing system is configured to determine a level of energy exerted by the human in performing the task.

10. The distributed system of claim **1**, wherein the carrier housing the accelerometer, wireless transmitter, and controller comprises a wristband.

11. A wearable device comprising:

a wristband having a body formed of one or more flexible straps; and

circuitry embedded in the wristband, the circuitry comprising:

an accelerometer;

a wireless transceiver;

a display; and

a controller operatively coupled to the accelerometer, the wireless transceiver, and the display, the controller being configured to (i) receive, via the wireless transceiver, a wireless transmission including a unique identifier associated with the wristband and a description of a task to be performed by a wearer of the wristband, (ii) render the description of the task on the display, (iii) receive acceleration data output from the accelerometer, and (iv) wirelessly transmit the acceleration data with the unique identifier, wherein the acceleration data is indicative of a status of a task.

12. The wearable device of claim **11**, further comprises a power source embedded in the wristband, the power source being operatively coupled to the accelerometer, the wireless transceiver, the display, and the controller.

13. The wearable device of claim **11**, further comprising a switch operatively coupled to the controller,

wherein, in response to actuation of the switch when the description of the task is rendered on the display, the controller is configured to reset a first physical memory location at which the acceleration data is stored.

14. The wearable device of claim **13**, wherein after the first physical memory location is reset, the controller stores contemporaneously generated acceleration data in the first physical memory location and associates the contemporaneously generated acceleration data with the task.

15. The wearable device of claim **14**, further comprising a heart rate monitor, wherein, in response to actuation of the switch when the description of the task is rendered on the display, the controller is configured to determine a level of energy exerted by the wearer of the wristband while performing the task.

16. A method in a distributed system, the method comprising:

receiving a first wireless transmission from a wearable device by a first wireless receiver, the first wireless transmission including a unique identifier;

generating a first parameter in a first physical memory location in response to the receipt of the unique identifier, the first parameter indicating an arrival of the human wearing the wearable device;

receiving, subsequent to the computing system setting the first parameter, a second wireless transmission from the wearable device by a second wireless receiver, the second wireless transmission including the unique identifier and acceleration data; and

receiving additional wireless transmissions from the wearable device, the additional wireless transmissions including the unique identifier and the acceleration data;

determining a status of a task being performed by the wearer of the wearable device based on at least the acceleration data received in the additional wireless transmissions, the second wireless receiver that receives the additional wireless transmissions, and a

duration over which the second wireless receiver receives the additional wireless transmissions.

17. The method of claim **16**, further comprising:

resetting a second physical memory location at which the acceleration data is stored in response to receipt of the first wireless transmission by the first wireless receiver;

storing the acceleration data in the second wireless transmission at the second physical memory location;

determining a second location of the wearable device based on the acceleration data in the second wireless transmission.

18. The method of claim **17**, further comprising:

resetting the second physical memory location in response to receipt of the second wireless transmission by the second wireless receiver; and

storing the acceleration data in the additional wireless transmissions at the second physical memory location.

19. The method of claim **16**, further comprising:

setting a second parameter in a third physical memory location in response to the receipt of the unique identifier a second time by the first wireless receiver to indicate a departure of the wearer of the wearable device.

20. The method of claim **16**, further comprising:

resetting the first parameter in the first physical memory location in response to the receipt of the unique identifier a second time by the first wireless receiver to indicate a departure of the wearer of the wearable device.

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